CLAIMS:

1. A diffraction grating device comprising:

first and second sets of elements, the first set of elements extending toward and being interdigitated with the second set of elements so that each element of the first set of elements defines an element pair with an immediately adjacent element of the second set of elements, and so that a first gap is defined between the elements of each element pair and a second gap is defined between each adjacent pair of element pairs;

means for moving the elements of the element pairs toward and away from each other to decrease and increase, respectively, the first gaps and to increase and decrease, respectively, the second gaps; and

means for projecting radiation toward the elements to produce diffracted radiation of at least one wavelength.

2. The diffraction grating device according to claim 1, wherein the diffraction grating device is a transmission grating and the projected radiation passes through the first and second gaps to produce the diffracted radiation.

3. The diffraction grating device according to claim 1, wherein the diffraction grating device is a reflection grating and the projected radiation is reflected by the elements to produce the diffracted radiation.

4. The diffraction grating device according to claim 1, wherein the elements of the first and second sets of elements are substantially parallel to each other.

5. The diffraction grating device according to claim 1, wherein the elements of each element pair comprise capacitive plates and the moving means

applies a voltage across the capacitive plates to cause the elements of each element pair to move toward or away from each other.

6. The diffraction grating device according to claim 1, wherein the projected radiation has a first wavelength range that encompasses the visible light spectrum, and the diffracted radiation includes a first wavelength within the visible light spectrum and a second wavelength outside the visible light spectrum.

7. The diffraction grating device according to claim 1, further comprising a third set of elements, the elements of the third set being between the elements of the element pairs so that the gap defined between the elements of each element pair is subdivided into two smaller gaps separated by one of the elements of the third set of elements.

8. The diffraction grating device according to claim 7, wherein the elements of the third set of elements do not move under the influence of the moving means.

9. The diffraction grating device according to claim 7, wherein the moving means causes the elements of the first and second sets to independently move toward and away from the elements of the third set to decrease and increase, respectively, the smaller gaps therebetween.

10. The diffraction grating device according to claim 1, wherein the diffraction grating device is one of a plurality of diffraction grating devices arranged in a planar array.

11. The diffraction grating device according to claim 1, wherein the diffraction grating device is one of a plurality of diffraction grating devices arranged in an arcuate array.

12. The diffraction grating device according to claim 1, wherein the projected radiation is selected from the group consisting of spectral, monochromatic, and polarized light.

13. The diffraction grating device according to claim 1, wherein the moving means operates digitally so that the elements of the element pairs have two steady-state positions relative to each other, wherein the first gaps between the elements of the element pairs are at a maximum width in a first of the steady-state positions, and the elements of the element pairs nearly contact each other to substantially eliminate the first gaps therebetween in a second of the steady-state positions.

14. The diffraction grating device according to claim 1, wherein the moving means has an analog operation so that the elements of the element pairs have more than two steady-state positions, in which the elements of the element pairs are movable between a first steady-state position at which the first gaps therebetween have a maximum width and a second steady-state position at which the first gaps have a minimum width.

15. The diffraction grating device according to claim 1, wherein the diffraction grating device is one of a plurality of diffraction grating devices that define pixels of a reconfigurable color image source.

16. The diffraction grating device according to claim 1, wherein the diffraction grating device is a frequency switch of an optical fiber.

17. The diffraction grating device according to claim 1, wherein the diffraction grating device is a component of a chromatograph.

18. The diffraction grating device according to claim 1, wherein each of the elements has an angled surface for recovering a portion of light energy lost to zeroth-order diffraction.

19. A variable diffraction grating device of a reconfigurable color image source, the variable diffraction grating device comprising:

a first set of elements extending toward and being parallel and interdigitated with a second set of elements, each element of the first set of elements defining an element pair with an immediately adjacent element of the second set of elements, a first gap being defined between the elements of each element pair, a second gap being defined between each adjacent pair of element pairs, the elements of each element pair comprising capacitive plates;

means for charging the capacitive plates so as to move the elements of the element pairs toward and away from each other to decrease and increase, respectively, the first gaps and to increase and decrease, respectively, the second gaps; and

means for projecting radiation at an angle relative to the first and second sets of elements, so that radiation is diffracted at two different wavelengths by reflection off of the first and second sets of elements, the second gaps being sized so that at least one of the two different wavelengths is in the visible light spectrum.

20. The variable diffraction grating device according to claim 19, wherein the first gaps are sized so that a second of the two different wavelengths is outside the visible light spectrum.

21. The variable diffraction grating device according to claim 19, further comprising a third set of elements, the elements of the third set being between the elements of the element pairs so that the first gap defined between the elements of each element pair is subdivided into two smaller gaps separated by one of the elements of the third set of elements.

22. The variable diffraction grating device according to claim 21, wherein the elements of the third set of elements do not move under the influence of the moving means.

23. The variable diffraction grating device according to claim 21, wherein the moving means causes the elements of the first and second sets to independently move toward and away from the elements of the third set to decrease and increase, respectively, the smaller gaps therebetween.

24. The variable diffraction grating device according to claim 19, wherein the diffraction grating device is one of a plurality of diffraction grating devices arranged in a planar array.

25. The variable diffraction grating device according to claim 19, wherein the diffraction grating device is one of a plurality of diffraction grating devices arranged in an arcuate array.

26. The variable diffraction grating device according to claim 19, wherein the moving means operates digitally so that the elements of the element pairs have two steady-state positions relative to each other, wherein the first gaps between the elements of the element pairs are at a maximum width in a first of the steady-state positions, and the elements of the element pairs nearly contact each other to substantially eliminate the first gap therebetween in a second of the steady-state positions.

27. The variable diffraction grating device according to claim 19, wherein the moving means has an analog operation so that the elements of the element pairs have more than two steady-state positions, in which the elements of

the element pairs are movable between a first steady-state position at which the first gaps therebetween have a maximum width and a second steady-state position at which the first gaps therebetween have a minimum width.

28. A method of diffracting radiation, the method comprising the steps of:

providing a diffraction grating device comprising first and second sets of elements, the first set of elements extending toward and being interdigitated with the second set of elements so that each element of the first set of elements defines an element pair with an immediately adjacent element of the second set of elements, and so that a first gap is defined between the elements of each element pair and a second gap is defined between each adjacent pair of element pairs;

moving the elements of the element pairs toward and away from each other to increase and decrease, respectively, the second gaps therebetween; and

projecting radiation toward the elements to produce diffracted radiation of at least one wavelength.

29. The method according to claim 28, wherein the diffraction grating device is a transmission grating and the projected radiation passes through the first and second gaps to produce the diffracted radiation.

30. The method according to claim 28, wherein the diffraction grating device is a reflection grating and the projected radiation is reflected by the elements to produce the diffracted radiation.

31. The method according to claim 29, wherein the elements of each element pair comprise capacitive plates and the moving step comprises applying a voltage across the capacitive plates to cause the elements of each element pair to move toward and away from each other.

32. The method according to claim 28, wherein the projected radiation has a first wavelength range that encompasses the visible light spectrum, and the

diffracted radiation includes a first wavelength within the visible light spectrum and a second wavelength outside the visible light spectrum.

33. The method according to claim 28, wherein the providing step comprises providing a third set of elements that are between the elements of the element pairs so that the first gap defined between the elements of each element pair is subdivided into two smaller gaps separated by one of the elements of the third set of elements.

34. The method according to claim 33, wherein the elements of the third set of elements do not move during the moving step.

35. The method according to claim 33, wherein the elements of the first and second sets independently move toward and away from the elements of the third set during the moving step.

36. The method according to claim 28, further comprising the step of arranging a plurality of the diffraction grating devices in a planar array.

37. The method according to claim 28, further comprising the step of arranging a plurality of the diffraction grating devices in an arcuate array.

38. The method according to claim 28, wherein the projected radiation is selected from the group consisting of spectral, monochromatic, and polarized light.

39. The method according to claim 28, wherein the moving step comprises digitally operating the elements of the element pairs to have two steady-state positions relative to each other, wherein the first gaps are at a

maximum width in a first of the steady-state positions, and the elements of the element pairs nearly contact each other to substantially eliminate the first gaps therebetween in a second of the steady-state positions.

40. The method according to claim 28, wherein the moving step comprises analogously operating the elements of the element pairs to have more than two steady-state positions, in which the elements of the element pairs are movable between a first steady-state position at which the first gaps therebetween have a maximum width and a second steady-state position at which the first gaps therebetween have a minimum width.

41. The method according to claim 28, wherein the diffraction grating device is arranged with a plurality of identical variable diffraction grating devices, the method further comprising the step of operating the variable diffraction grating devices as a reconfigurable color image source.

42. The method according to claim 28, wherein the diffraction grating device is operated as a frequency switch of an optical fiber carrying multiplexed signals.

43. The method according to claim 28, wherein the diffraction grating device is operated as a component of a chromatograph to identify substances in a plasma.

44. The method according to claim 28, wherein each of the elements has an angled surface so as to recover a portion of light energy lost to zeroth-order diffraction.

45. A method of manufacturing a diffraction grating device, the method comprising the step of etching a layer overlying a cavity in a surface of a substrate to form trenches that delineate first and second sets of elements, the first set of elements extending toward and being interdigitated with the second set of elements so that each element of the first set of elements defines an element pair with an immediately adjacent element of the second set of elements, and so that a first gap is defined between the elements of each element pair and a second gap is defined between each adjacent pair of element pairs, the elements of the element pairs being movable relative to each other in directions toward and away from each other to decrease and increase, respectively, the first gaps and to increase and decrease, respectively, the second gaps.

46. The method according to claim 45, further comprising the step of forming means for moving the elements of the element pairs toward and away from each other to decrease and increase, respectively, the first gaps and to increase and decrease, respectively, the second gaps.

47. The method according to claim 45, wherein the elements of the first and second sets of elements are formed so as to be substantially parallel to each other.

48. The method according to claim 45, wherein the elements of each element pair are formed to be capacitive plates.

49. The method according to claim 45, further comprising the step of forming a third set of elements, the elements of the third set being between the elements of the element pairs so that the gap defined between the elements of each element pair is subdivided into two smaller gaps separated by one of the elements of the third set of elements.

50. The method according to claim 49, wherein the elements of the third set of elements are formed so as not to move under the influence of the moving means.

51. The method according to claim 49, wherein the elements of the first and second sets are independently movable toward and away from the elements of the third set to decrease and increase, respectively, the smaller gaps therebetween.

52. The method according to claim 45, wherein the diffraction grating device is formed as one of a plurality of diffraction grating devices that define pixels of a reconfigurable color image source.

53. The method according to claim 45, further comprising the step of etching each of the elements to have an angled surface for recovering a portion of light energy lost to zeroth-order diffraction.